INT MISC

PROBLEM SELECTION STATEMENT
FOR
LINE PROJECT FS-INT-1602
SOIL STABILIZATION

The Soil Stabilization project, headquartered at Boise, Idaho, is titled "Preventing or Controlling Accelerated Erosion of Unstable Forest Soils." Its research objectives are to determine quantitatively the effects of site factors, forest conditions, and present management practices on the stability of fragile soils, particularly those derived from the Idaho Batholith; and, based upon these relations, to develop management practices to maintain or improve soil stability, prevent or control accelerated erosion and sedimentation, and maintain high water quality.

This project is based on the existence of the critical problem of maintaining an acceptable degree of soil stability of the granitic soils under the impact of land uses. Specifically, this project's mission is concerned with research on processes of and factors affecting soil erosion on forested lands under use and nonuse; surface and subsurface hydrology of this large area of "problem" soils; the stabilization of logging disturbance and the vegetative stabilization of road cuts and fills; the source, movement, and deposition of sediment; and improvement of damaged anadromous fish spawning beds.

Problem Situation

The so-called granitic soils are actually derived from the Idaho Batholith formation, a quartz monzonite-granite complex of late Jurassic or early Cretaceous age. Quartz monzonite comprises about 65 percent of the geologic parent material. The extensiveness and importance of these soils are shown by the fact that, of approximately 53.5 million acres of land in Idaho, about 13 million acres or 24 percent is underlain by this or closely related formations. Breakdown of this rock is primarily by physical rather than chemical weathering. Lack of high base content of the rock, coupled with relatively low precipitation (about 20 to 30 inches) favors weathering that results in a coarse-textured soil predominantly of single-grain structure. Mechanical analyses indicate an average combined clay-silt fraction content of 5 to 10 percent. Organic matter production is relatively low and the oxidation rate is high.

Topography of this area is steep and rugged. Slope gradients often range as high as 100 percent or more. Soil depth is highly variable, but generally rather shallow. The Zena Creek Soil Survey report,

coupled with laboratory analysis, depict common characteristics. Of the 10,203 acres surveyed, 3,182 acres or about 30 percent of the area have soils ranging in depth from less than 6 inches to 16 inches. The average slope gradient for these shallow soils range from 60 to 75 percent. Average available water-holding capacity in the top foot of this group of shallow soils ranges from 0.85 to 1.74 inches. All of these characteristics, singly or in combination, contribute to soil instability.

Between 5 to 10 million acres of mature timber grow on these fragile lands. Timber surveys on the Boise and Payette National Forests indicate an average per-acre volume of about 13,000 bd.ft., principally ponderosa pine, but with lesser amounts of Douglas-fir and Engelmann spruce. To minimize losses by insects, diseases, and fire; to permit regeneration of a new timber crop; and to contribute regularly to timber-based economies, this mature timber should be harvested. Unfortunately, conventional methods of logging cause extensive soil erosion, and the resulting sedimentation menaces fish habitat, reservoirs, and other water-handling structures.

Data from a southwest Idaho timber management study further illustrate the criticalness of this problem. Over the Boise, Payette, and part of the Sawtooth National Forests, 26 percent of the area and 22 percent of the volume of commercial timber is considered nonloggable because of rough, steep topography and instability of the soils. If these lands could be logged commensurate with the protection of soil and water resources, the annual allowable cut could be increased by 25 percent. Similar troublesome problem areas exist on the Nezperce, Clearwater, and Bitterroot National Forests. To illustrate the fragility of these timbered soils, on the Magruder District of the Bitterroot Forest where multiple use operations (including logging) are planned, about 75 percent of the area has high to very high erosion hazards under existing conditions. Potential erosion hazards from road construction are rated high to very high on 85 percent of the area.

The South Fork of the Salmon River is rated the number one stream in the entire Salmon River drainage network for the numbers of fish nests, based on 10 years of actual survey records. Various estimates of the per-acre value of spawning grounds have been made. One estimate currently applied is $100,000 per acre (based on Canadian studies) for commercial fishery purposes. For sport fisheries, the value per acre would exceed the above estimate. Increasing concern is developing rapidly about the effects of land use and the resulting sedimentation in spawning streams. The Forest Service has received criticism for its timber harvesting practices that are allegedly the cause of increased sedimentation. This issue has been raised repeatedly, and a joint investigation of damages is being made by the Idaho Fish and Game Department and the Forest Service.

Sedimentation causes damage to spawning beds, principally in two ways. Deposits cover desirable spawning areas to various depths, making the stream bottoms less permeable to oxygen which is vital to the survival of eggs and fry. Secondly, sediment covers or scours stream bottoms, thereby destroying fish food.

The importance of preserving fish habitat is reflected by the recent decision to select the High Mountain Sheep Dam site, about one-half mile above the confluence of the Salmon and Snake Rivers, rather than the Nezperce site below the confluence. By so doing, the Salmon River is maintained free of major obstructions to the passage of anadromous fish. Further impetus to stream protection is contained in the designation of certain streams as wild rivers to maintain them undamaged. To achieve this objective will require close scrutiny of land management practices bordering on or affecting these streams.

Import is given the above situation by Secretary Freeman in a letter dated August 16, 1961, to the Secretary of the Army, Elvis J. Stahr, Jr., "Streambeds on the National Forest lands tributary to the Salmon River furnish essential spawning areas for the valuable salmon and steelhead fishery of the Columbia River and the protection of this resource is one of the important purposes of National Forest lands in this area." This is substantiated by survey results of several years, that show: of the total number of fish that enter the Columbia River, 29 percent originated in Idaho.

These conditions constitute a genuine and pressing challenge to land managers. When the economics as envisioned in the economic operability concept are superimposed, the challenge takes on an even greater magnitude. Intensive coordinated research is clearly indicated to solve the soil instability problem, because the use of all resources has a definite impact on behavior of these watersheds. Of particular importance is the necessary coordination with engineering, timber, and other watershed management research--which will be outlined later.

Project Mission Problems

An examination of the project mission reveals four distinct problems needing research. Essentially, they include gathering basic information of the area to characterize "normal conditions" as a basis for research pertaining to onsite and offsite disturbance, erosion, and sediment production.

Problem 1. Characterization of the lands of the Idaho Batholith with respect to soils, climate, vegetation, landform, and geology. This work is fundamental to the following problems relating to soil stability, and, hence, must be continuing. This problem covers the need

for determining soil properties and characteristics, climatic patterns, runoff and sediment production, and vegetation characteristics under natural conditions to provide a basis for comparisons of changes under use.

Problem 2. Quantify the hydrologic functioning of Batholith lands, including impacts on erosion. Hydrologic processes are influenced strongly by the prevailing climatic patterns. Rain-on-snow events, high-intensity rains, and prolonged low-intensity storms produce varied and often erratic watershed behavior. Steep slopes, shallow and coarse-textured soils, and numerous sparsely vegetated areas permit rapid runoff that causes high peak discharges. Subsurface seepage flow occurs commonly; and, where it is intercepted by soil disturbance, this flow concentrates and causes accelerated erosion or mass soil movement. High peak flows flush copius quantities of sediment down channels, and a better understanding of discharge-sediment-transport relations is needed. The effects of altering hydrologic processes by different land uses must be defined in relation to potential hazards.

Problem 3. Development of rehabilitation treatments for disturbed or deteriorated lands to restore satisfactory levels of soil stability and productivity. Effort should be directed to ways to quickly restore protective vegetative cover to damaged areas, including that caused by attendant road construction. Cover restoration is needed also on areas undisturbed by logging, but whose sparse cover is inadequate to provide the needed soil stability. Data currently available show that road construction and improper maintenance account for the major portion of watershed damage sustained from a logging operation. Therefore, developing methods for vegetative stabilization of road cuts and fills on steeply sloping granitic soil areas is a high-priority phase of this problem. Mass slumping and soil slippage is a common phenomenon in the granitic soil area, and research on control measures is an important segment of this problem.

Problem 4. Evaluation of the impacts of different land uses on sedimentation and the effects of sedimentation on such stream-associated values as channel stability, fish habitat, spawning beds, reservoirs, and other improvements. The scope of this problem pertains to offsite damages. Growing concern, reaching a clamor in some instances, is being expressed over apparent sedimentation and destruction of anadromous fish spawning beds. This is especially true of the Salmon and Selway Rivers and others common to the granitic soil areas. Additionally, reservoir and channel storage is being depleted rapidly. While any treatment successfully developed for problem No. 3 will have material and beneficial results on this problem, it is of sufficient importance to be considered separately. Here, we are concerned with the physical movement of sediment into channels, the

capacity of stable channels to handle increased loads from slopes, the addition of sediment by the degradation of stable or unstable channels, the movement in quantity and rate from tributary to main channels, and its deposition, shifting, and redeposition further downstream. Research on ways to arrest, dissipate, or otherwise control offsite sediment production and sedimentation effects on fish habitat is urgently needed.

Problems Selected for Study

All problems have been selected to receive research attention with our present staffing. Much of the timber on granitic soil areas in the Intermountain and Northern Rocky Mountain Regions is mature. Local economies are geared to logging and timber processing operations. Conventional methods of road construction and logging create grave problems of erosion and sedimentation. These, in turn, menace the highly valuable fish habitat, canals, and reservoirs. To sidestep this critical problem of soil instability and classify these extensive areas as inoperable, is not in keeping with a positive approach to multiple use management of the land and its resources. For this reason, we are dividing our efforts between the four problems described above.

Additional characteristics of these problems that warrant attention simultaneously follow:

Analyses of precipitation data from the Zena Creek Logging Study area show that high-intensity storms pose a threat to stability of both roads and sparsely covered slopes. Once every 4 years we can expect (with 50-percent probability) a 15-minute summer storm intensity of 3 inches per hour; in every 13 years, a storm intensity of 5 inches per hour.

Natural erosion and sedimentation rates in the granitic soil area are high. Two streams (Tailholt and Circle End) have been gaged since 1962. Average runoff and sediment production have been higher from Tailholt, although Circle End was burned over a large part in 1947. For 3 years (1962-65), Tailholt Creek has discharged sediment at the rate of 206 lbs. per day per square mile. All of this is bedload. Repeated measurements of suspended sediment show that it is negligible except during peak runoff.

An infiltrometer plot study in the Zena Creek area showed that runoff was seven times and sediment production 17 times greater on logged southwest than on logged northeast exposures. On unlogged areas, runoff was twice and sediment production was 13 times greater on southwest-facing than on northeast-facing slopes. Further study of the apparently greater natural erodibility of soils on south-facing

slopes suggests that relative erosion from two sites differing in aspect is conditioned by the relative irradiation received. This hypothesis is supported tentatively by other data from Arizona and California.

A hydrologic analysis of two small watersheds predicts a substantial increase in runoff and sediment production after logging, and an even greater increase due to road construction. For this reason, plans for constructing a model logging road have been held in abeyance.

Both Regions 1 and 4 are faced with similar decisions on the management of Batholith soils. Creation of a Batholith steering committee and a new position on the staff of the Regional Forester illustrate the gravity of the management situation. To meet the urgent needs for improved practices, our program can best be directed in breadth at the present. Although we cannot learn everything needed in a short time, research findings related to any facet of the Batholith will have ready application.

In summary, selection of all problems for research is based upon: (1) Utilizing immediately and fully the diverse research skills available, (2) the immediate application of fruitful research accomplishments, and (3) the excellent cooperation and coordination developed with Regional and Forest staffs and Station divisions.

Coordination

Common interests and related objectives exist between watershed management and engineering research in this Batholith soil problem area. Procedures for evaluating and interpreting soil movement and attendant damages to watershed functioning are the responsibility of watershed management research. Engineering research is responsible for the design, fabrication, and functional testing of logging equipment, road design, and studies of the efficiency of different transportation systems. Stabilization of disturbed soils is of interest to both projects; and, in this area, coordination to prevent overlap is necessary. Research in the area of assessing and evaluating watershed damages induced by different logging methods, road design, and transportation systems, requires close coordination. Problem analyses should have concurrence between projects and some joint study plans covering areas of mutual interest may be appropriate.

The assigned missions of INT Projects 1202, 1601, and 1603 need to be considered as they relate to Project 1602. Project 1202 is concerned with the silviculture of ponderosa pine and Douglas-fir, and would relate to soil stabilization in the establishment of new stands and their growth in providing soil stability in the granitic soil area. Project 1601 is concerned with streamflow regulation and

sediment reduction in Northern Rocky Mountain forests. There is an area of relatedness in the occurrence of sensitive soils in both project areas. Additionally, long-term harvesting studies in relation to water yield and sediment production, planned for Horse Creek, may relate to Project 1602. Coordination is necessary in this area. Project 1603 has responsibility for restoration of cover to deteriorated high-elevation range watersheds. Among this project's efforts to characterize the environment of these sites and test the adaptability of different species in providing site protection, some plants of mutual benefit may be found. Projects 1602 and 1603 should coordinate and collaborate in the area of plant selection and testing

Finances

The gross budget for this project in F.Y. 1968 is $92,643. This provides three full-time scientists and one technician. Staffing with additional technicians is planned when appropriations permit.

Prepared by: John L. Copeland, Assistant Director _____
Date

Concurrence by: _____, Project Leader _____
Date